Access to and Diffusion of Climate Change Adaptation Information among Rice Farmers in Southeast Nigeria

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Abstract: **This study investigated how access to and diffusion of agricultural information contributed to rice farmers' adaptation to climate change and variability in Southeastern Nigeria. The major research problem this study sought to address was how information on adaptation to climate change and variability is accessed and diffused among rice farmers to enhance their adaptation to climate change. This problem was borne out of the fact that a lot of rice farmers keep lamenting about how their crops were washed away by floods and the effects of other climatic conditions which they do not have the solution to except finding a way to adapt and mitigate this global phenomenon known as climate change. Specifically, the study was designed to find out the extent of access to information which rice farmers in southeast Nigeria have on climate change adaptation and to know the channels of communication that is the major source of information on climate change adaptation. It also aimed at determining the relationship that exists between variables like access, diffusion, adoption of innovation and adaptation to climate change as well as as certain the factors that influence the adoption or non-adoption of innovation of climate change adaptation rice farmers in southeast Nigeria. The study was underpinned by Rogers' Diffusion of Innovations theory. Survey method was adopted for the study with the questionnaire used to collect data. The study population was made up of rice farmers in Anambra, Enugu and Ebonyi states. A multistage sampling procedure was employed to select 900 respondents for the study involving both probability and nonprobability sampling methods. The key findings showed that rice farmers' access to information on climate change adaptation was high and they identified periodical seminars and workshops organized by government extension workers and Non-Governmental organizations as their major sources of information on climate change adaptation. Apart from Radio which was found to be one of the major sources of information among the rice farmers, TV and newspaper were found not be effective in disseminating information on climate change adaptation to rice farmers in southeast Nigeria as most of them do not have access to the channels. The study, therefore, recommended that various channels of communication, especially radio, should be employed to disseminate information on climate change adaptation strategies to reach a broader audience.**

Keywords**: Access, Diffusion, Climate Change, Adaptation Information, Rice Farmers**

I. INTRODUCTION

Climate change is a major environmental problem in the world that has attracted concerted efforts at preventing, reducing and controlling the menace through the use of communication in the form of mediated and interpersonal messages on climate change adaptation measures. However, scholars like Abiodun, Salami, and Abatan (2013, p.l) observe that despite these efforts, climate change remains a leading environmental problem in Nigeria especially in the areas of agriculture, water resources, industry and human health.

Globally, climate science generates agricultural information aimed at improving farmers' agricultural production and mitigating the adverse impacts of climate change. Over the last few years, tremendous advances have been made in climate science worldwide (Tarhule 2007). However, Tarhule (2007) argue that this progress has not benefited many rural farmers in Africa as a result of poor dissemination of information on climate change. Besides, there is scanty research on how access to information and its use by farmers has the potential to mitigate the adverse impacts of climate change and ultimately enhance agricultural development. Farmers' access to information on climate change and their diffusion of such information is of paramount importance if their adaptation and development are to be sustained (Chikozho 2010).

Like sub-Saharan African countries, Nigeria is highly susceptible to the effects of climate change (IPCC 2007; Apata, Samuel and Adeola, 2009). Nonetheless, climate change is a risk to agriculture and non-agricultural socio-economic growth. Agricultural production actions are largely more susceptible to climate change than other divisions. This is because agricultural production in most African countries, especially Nigeria depends on weather and climatic activities. The mixture of high climatic changeability, inadequate infrastructure and a variety of other difficulties connected with climate capriciousness will create significant challenges for African countries and Nigeria in specific.

Gwambene (2007) explains that the adversative effects of climate change on agricultural production in developing nations are triggered by the low levels of adaptive capacity, and limited use of technology and innovation. Evidence shows that effective measures (adaptation and mitigation) against climate change are available, yet the impact of climate change persists, mainly because most people at the risk communities are unaware of the measures; they are unable to accept them; or that the measures are inaccessible. Umeje, (2010, p.2)

identified lack of education, information and access to effective communication as a significant constraint to the success of climate change adaptation measures, especially among those at-risk communities. However, vulnerability to climate change in the agricultural sector of many sub-Saharan African countries can be assuaged with a suitable distribution of accurate information to farmers.

Accordingly, adaptation was viewed as a practical opportunity in plummeting susceptibility related to the predicted adverse effects of climate change (Jones, 2010). Adaptation approaches are those tactics that allow the individual or the community to cope with or adjust to the impact of climate in the local areas. Such approaches will include the adaptation of early maturation crops, drought-resistant variability and careful possession of livestock in areas where rainfall deteriorated. However, for adaptation to take place effectively, there must be access to and diffusion of climate adaptation information among farmers who may be unaware of adaptation strategies.

In the same vein, diffusion is a special type of communication concerned with the spread of messages that are perceived as new ideas (Elia, 2013). In the context of this study, it refers to the spreading of agricultural information containing new ideas, technologies, products and processes that are packaged for the adaptation of climate change effects among rice farmers.

Diffusion of climate change adaptation information is, therefore, the spreading of information containing climate change adaptation strategies like cultivating different types of crop, shortening the growing season, changing extent of land put in crop production, use of irrigation as a water source, use of chemical fertiliser, mulching, planting of cover crops, planting of resistant crop varieties, changing of planting dates, adoption of new techniques and use of drainage system. Whether rice farmers in Southeast Nigeria have access to this information and how it is diffused among them to enhance adaptation to climate change effects is the focus of this study.

Timely access to climate change information is of the utmost importance if adaptation and development are to be sustained (Chikozho, 2010). Some researchers have discovered that, notwithstanding other reasons which affect adaptation to climate change, information and information diffusion profoundly activates and improves the ability of farmers to adjust. Such researches, particularly, the one conducted by Mengistu (2011) in Ethiopia, discovered that access and availability of timeous information on climate change was a requirement to adaptation and mitigation of the adversative effect of climate change. In East Africa, Kandji and Verchot (2017) discovered that climate change information was an essential feature for local people to make the right choices in agriculture and other socio-economic actions including adaptation to climate change effects.

Information dissemination, which in this context denotes to ensuring the availability of agricultural information to farmers, plays an essential role in encouraging farmers' adoption and use of innovations in coping with climate change impacts (Rogers 2003). However, the major challenge that Kadi, Njau, Mwikya and Kamga, (2011) discovered that the information which would have assisted the farmers in adapting to climate change had not been disseminated effectively. According to Kandji and Verchot (2007), information on climate change is a significant element if farmers should make the right agricultural decision and other socio-economic actions intended to enhance their livings. Farmers' effective adaptation to climate change effects is crucial in improving yields and helping agricultural growth among rice farmers in Southeast, Nigeria.

For rice farmers in Southeastern Nigeria to be able to cushion the effects of these devastating effects of climate change, they must have access to timely information on climate change adaptation strategies (Batta, Ashong, and Abdullahi, 2013). The is geared towards the goal of reducing the impact of climate change by having a positive behaviour change emanating as a result of the audience knowledge of the adaptation and mitigation actions disseminated through various media such as the radio, television, video, printed materials, interpersonal communication and new media. However, there seems to be a lack of adequate access to and diffusion of climate change adaptation information among rice farmers in Southeastern Nigeria which may be the reason why they suffer the most devastating effect of climate change on their farmlands. It is based on the foregoing that this study evaluated how access to climate change adaptation information diffuse and enhance adoption of innovation among farmers engaged in rice production in southeastern Nigeria. Adopting DOI, the study examined how information gathered through research is packaged and distributed to rice farmers in Southeastern Nigeria to empower them to alleviate the adverse effect of climate change.

Statement of the Problem

Consumers are exhibiting a shift in preference from traditional staple food (such as cassava, maize and yams) to rice (Nigerian National Food Reserve Agency, Federal Ministry of Agriculture and Water Resources, Japan International Cooperation Agency, 2009). Consequently, there is a demand of 5 million MT of rice yearly in Nigeria. However, only about 3.2 million MT is produced locally (Federal Ministry of Agriculture and Rural Development, FMARD, 2012) with a demand gap of 1.8 million metric tons. The inability to meet rice consumption needs through local production makes the country import-dependent (Akinbile 2010). Estimates indicate that over 90 per cent of domestic rice production comes from resource-poor and weakly organised smallholders (Cadoni and Angelucci 2013). These smallholders apply a low-input strategy to agriculture, with minimum input requirements and low output (International Fund for Agricultural Development [IFAD], 2009). A host of challenges has constrained the livelihood of these smallholder farmers: low productivity; the paucity of opportunities for value addition; limited access to productive assets and inputs; inadequate support services (extension and research); inadequate market and rural

infrastructure; post-harvest losses and a constrained enabling environment (IFAD, 2012).

Most of these challenges were caused by climate change and variability. Consequently, many rice farmers in Southeastern Nigeria continue to grieve over the high impact level of climate change, which has severe consequences for economic development and growth. For these rice farmers to cope, adapt and mitigate these adverse impacts of climate change and variability, they need to have access to adaptation information and knowledge in agricultural production. Lack of timely access to information impedes farmers' ability to make a decision such as what to plant, where to plant, in which season and how to ensure food is preserved. It also affects farmers utilising opportunities arising due to climate variability, access to markets, coping knowledge to engage in other economic activities and so on. Farmers will fail to adopt and practice new knowledge if the information disseminated does not reach the targeted farmers on time**.**

Objectives of the Study

The general objective of the study was to evaluate access to climate change adaptation information and how its diffusion influences adoption of innovations among rice farmers in southeast Nigeria. The specific objectives of the study were:

1. To find out the extent of access to information which rice farmers in southeast Nigeria have on climate change adaptation strategies.
2. To ascertain which among the channels of communication is the major source of information on climate change adaptation among rice farmers in southeast Nigeria and why
3. To determine the relationship between access to information and the diffusion of information on climate change adaptation among rice farmer in southeast Nigeria.
4. To determine the relationship between information diffusion and adoption of innovation among rice farmer in southeast Nigeria
5. To determine the relationship between the adoption of innovation and adaptation to climate change effects among rice farmer in Southeast Nigeria?
6. To determine the factors that influence the adoption or non-adoption of innovation of climate change adaptation information by rice farmers in southeast Nigeria.

Research Questions

The following research questions were adopted for the study

1. What is the extent of access to information which rice farmers in southeast Nigeria have on climate change adaptation strategies?
2. Which among the channels of communication is the major source of information on climate change adaptation among rice farmers in southeast Nigeria and why?
3. What is the relationship between access to information and the diffusion of information on climate change adaptation among rice farmer in southeast Nigeria?
4. What is the relationship between information diffusion and adoption of innovation among rice farmer in southeast Nigeria?
5. What is the relationship between the adoption of innovation and adaptation to climate change effects among rice farmer in Southeast Nigeria?
6. What are the factors that influence the adoption or non-adoption of innovation of climate change adaptation information by rice farmers in southeast Nigeria?

Research Hypotheses

The researcher tested the following hypotheses for the Study:

H_1 Access to information enhances the diffusion of information on climate change adaptation among rice farmers in southeast Nigeria.

H_2 Information diffusion promotes the adoption of innovation among rice farmer in southeast Nigeria

H_3 Adoption of innovation enhances adaptation to climate change effects among rice farmer in Southeast Nigeria

Theoretical Framework

The researcher adopted the Diffusion of Innovation (DOI) Theory for this study. Diffusion of Innovation (DOI) Theory was developed by E.M. Rogers in 1962; it is one of the foremost theories in social science. It was initiated to elucidate how an idea or product increases energy and diffuses (or spreads) through a definite populace or social system over time. The result of this diffusion is that people, as part of a social system, adopt a new idea, behaviour, or product. Rogers (2003, p.12) defined innovation as an idea, object or practise that is perceived as new by members in a social system. Diffusion is the progression through which an innovation is broadcasted by the use of various conduits, over time, among the affiliates of a social system (Rogers 2003, p. 5). Innovation in this research is seen in the framework of climate change adaptation approaches which have been announced to farmers as a result of climate change events.

Elia (2013) explains that DOI describes a transformation agent as a person who tries to influence users' innovation-decisions in a way that is considered necessary by a transformation agency. In this respect, the type of systems and the roles opinion leaders play, control the probability that the innovation will be accepted. Opinion leadership has been described as the extent to which a person can inspire other persons' attitudes or explicit behaviour unceremoniously, in an anticipated way, with comparative regularity (Rogers 2003, p. 27). Opinion leaders wield influence on peoples' behaviour through their acquaintances, but supplementary mediators called transformation agents and janitors are also involved in the process of diffusion. In this study, government leaders at

the village level and influential people in the village are referred to as opinion leaders. Their role is to sensitise farmers on innovations which aim to improve their livelihoods. Information is disseminated and channelled through various means such as agricultural extension officers, person-to-person, community radio, research findings dissemination workshops, government agencies, politicians, government leaders, television, flyers and brochures. Indeed, without these channels, the farmer cannot have access to new agricultural innovations practices such as research on new varieties of seeds which are drought and disease tolerant, new farming practices, small-scale irrigation, water conservation mechanisms such as harvesting, change and use of technology in farming, diversification on agriculture and food conservation techniques.

The new agricultural knowledge acquired by the farmers will either be adapted to suit their environment or neglected (non-adaptation). To adapt, farmers will need supporting mechanisms or an environment which enhances the knowledge transformation to impact agricultural production. These include timely access to information, a well-framed institutional framework for information transfer, proper infrastructure, confidence as a result of practice and the availability of financial services. On the other hand, the failure to adapt can be caused by the lack of timely access to information sources, education (formal or informal), attitude, poverty, economy, inadequate knowledge, poor infrastructure such as roads and dwellings, and ignorance.

It is hence anticipated that when farmers have access to information and adapt to new agricultural practices, there is a higher chance that food production will increase at the level of households and nationally will enhance food security. However, the fight against food insecurity cannot be achieved without reflecting on climate change and variability as a serious threat to agricultural production. The above explanations show a mutual relationship between agricultural crop production and climate change and variability. For farmers to cope, adapt and mitigate the adverse impacts of climate change and variability, they need to have adaptation information and knowledge in agricultural production. Lack of timely access to information impedes farmers' ability to make a decision such as what to plant, where to plant, in which season and how to ensure food is preserved. It also affects farmers utilising opportunities arising due to climate variability, access to markets, coping knowledge to engage in other economic activities and so on. Farmers will fail to adopt and practice new knowledge if the information disseminated does not reach the targeted farmers on time. Therefore, this study investigated how the information on adaptation to climate change and variability is packaged and disseminated to farmers within the agricultural sector in Southeastern Nigeria.

II. LITERATURE REVIEW

Factors Affecting Access to, and Use of, Information on Adaptation to Climate Change

The literature has shown that information on farmers' awareness concerning climate change and variability is crucial to the current mitigation and adaptation strategies like the adoption of efficient agricultural and environmental practices such as planting of early maturing crops, new drought-resistant varieties in areas where there is a decline in rainfall. This is aimed at reducing the vulnerability of rice farmers' climate change effects. Some scholars have stressed the importance of, and need to, ensure that information on adaptation for climate change is distributed to farmers. Salinger, Sivakumar and Motha (2005) pointed out that the serious challenges involving vulnerability are reduced in the agricultural sector. They suggest this is achieved by making better use of the existing information and dispersion of knowledge to the farm level. The authors explained that the best way to ensure that information is disseminated well to farmers is by using a combination of methods. The old methods, such as visiting farmers and using extension services should be combined with the new information and communication technologies this, should be adapted to local settings.

Salinger, Sivakumar and Motha (2005) have warned that the limited access to, and absorption capacity for, new technologies in developing countries and lack of appropriate local information on how to implement them under their local conditions is detrimental to the regional adaptation strategies. This argument has been supported by Deressa et al. (2008), who discovered that many farmers (42%) in the Ethiopian Nile Basin did not have access to information on adapting to climate change and variability and hence continued to use indigenous agricultural methods in cultivation.

Gunasekera (2011) study on how to reduce impediments to adaptation found that efficient and effective adaptation measures can contribute to reducing the adverse impacts of adaptation. These measures have been identified as access to reliable and detailed information, improved communication, information dissemination, improved public and private sector responsibilities in adaptation to climate change and variability and integration of adaptation into farm decision making. The study shows that effective and efficient adaptation is being influenced by timely recognition of the need to adapt, adaptation ability and incentives to adapt. Gunasekera emphasizes the point that adaptation can be improved through enhancing access to, and use of, research information generated in both quantity and quality packages.

Access to rural services such as credit, agricultural extension and information about climate change and variability played a significant role in the use of adaptation options by farmers (Deressa et al. 2008). These authors revealed a positive correlation between credits, agricultural extension and access to information on climate change and variability in fostering the adaptation process. Munyua (2011) observed that in Tanzania and Kenya, respectively, agricultural extension, social networks and village government leaders were key factors in disseminating agricultural information to local communities for agricultural development.

To enhance the usage of information on climate change and variability by farmers, Mutekwa (2009) study in Zimbabwe gave insights into the need for agricultural extension officers to fully train and educate farmers on the significance of seasonal climate forecast information usage. This training will, in turn, assist farmers in distributing their limited resources through decisions towards farming practices. The study of Ingram, Roncolli and Kirshen (2002) goes beyond the notion of educating farmers, by stressing that farmers need more extensive descriptions and interpretation of information on climate change and variability. Farmers need to be educated on the forecast limitations, risks and possible ways of responding to abnormal changes in the information provided.

Information on adaptation to climate change and variability by farmers can neither be accessed nor utilized where there are weak research institutes and extension services. Manda (2002) observed that, in Tanzania, for information to enhance the agricultural development, institutional funding, agricultural research and extension should be prioritized. Also, marketing and transportation infrastructure constraints and gender inequality limitations should be addressed. He further points out that this will ensure the establishment of strong links between agricultural research institutions, extension services and farmers to assess the information needs of farmers for effective information generation and dissemination.

Agwu, Ekwueme and Anyanwu (2008) observed there was low usage of improved agricultural information, disseminated through radio programmes. This low usage was influenced by factors such as age, farming experience, poor social participation and poor access to credit facilities. This study revealed that the educational level of farmers contributed significantly to the adoption of new technologies. They observed that illiterate farmers could not follow even simplified technical language broadcast. The study by Ingram, Roncoli and Kirshen (2002) highlighted the importance of using the local language on radio programmes in the dissemination of information to farmers.

The study of Deressa et al. (2008) showed that access to and use of, information for adaptation was promoted by household characteristics, which include the level of education, sex and age of the head of the family and family size. A higher level of education is linked to the wider access to information on climate change and variability, higher agricultural productivity and improved technologies (Deressa et al. 2008). Education plays a key role in creating awareness which, in turn, assists in farmers' adaptation measures. Deressa et al. (2008) found that, unlike female-headed households, male-headed households were more likely to access and utilise agricultural information and adapt to climate change and variability. The explanation is that agricultural work, for the most part, is done by men. However, this argument seems to relate to, and yet differ from, that of Manda (2002) whose findings revealed that in other African countries such as Tanzania women are less likely to access and utilise agricultural information than men. This is due to cultural issues.

According to Mattews-Njoku, Adesope and Iruba (2008, p. 409-410), the smaller the household, the less likely it is to utilize and apply the information on agriculture for adapting to climate change and variability. This is because adaptation is confined to the availability of resources such as labour, which is an essential human capital in agricultural production. Ingram, Roncoli and Kirshen (2002), studied farmers in Burkina Faso and noted that access to, and use of, information on adaptation was influenced by farmers' access to credit and improved agricultural technology. These factors determined the ability of farmers to respond to climate changes and Variability by gaining access to new crop varieties, fertilizers, labour and land.

Ingram, Roncoli and Kirshen (2002) discovered that usage of information on climate change and variability was not only enhanced by farmers' access, relevancy, timeliness of disseminated information, but also its credibility. This is due to farmers' investing much of their resources, capital and human endeavour in improving agricultural production for sustaining their livelihood. Thus, having unreliable information, as in forecasts, would affect their urge to invest. Irrelevant information may result in the abject and irreversible poverty of the farmers. Their study stresses the importance of not only delivering credible information on climate change and variability but also emphasizing that its usage can only be assured by making sure farmers can interpret and understand the disseminated forecasts in their local setting.

The farmers' experience has been observed by authors (Ingram, Rancolli and Kirshen 2002; Ngigi, Savenije, Rockstrom and Gachene 2005) to be a factor which influences farmers' use of information on climate change and variability. A poor harvest signals the quest for information on seasonal climate change and variability such as onset and end of the rainfall; this is often in high demand. If the farmer used the forecast information, and it caused adverse effects on crop production, a farmer might be afraid and refrain in the next season from relying on the same source of information. This is due to the high-risk factor involved in practising farming, as poor agricultural production seriously affects a farmer and thus exacerbates his or her vulnerability.

In most studies, the benefit aspect of the information on adaptation is taken for granted. Researchers assume that farmers will respond after receiving information which enhances their adaptive capacity. However, Fraisse, Breuer, Zierden, Bellow, Paz, Cabrera, Garcia, Ingram, Hatch, Hoogenboom, Jones, and O'Brien (2006) observed that in the USA disseminating information to farmers and ensuring its access was not enough to trigger its usage. The study found that information on climate change and variability usage was highly promoted by observable adaptive response options which are expected when a farmer decides his farming practices. Thus the study came up with AgClimate, a web-based information system, which was used by farmers,

extension officers, crop consultants and policymakers as a tool for proactive adaptations to seasonal and inter-annual climate change and variability forecasts.

The literature reviewed has shown that socio-economic and institutional factors are major determining factors influencing access and use of information on climate change for adaptation. Other factors such as attitude, experience, effective information dissemination and commitment also influence access to and use of information and knowledge for farm-level decision-making.

III. METHODOLOGY

The Survey design was adopted for the study. The survey research design is considered appropriate for this study because it will help in assessing the audience level of access to climate change adaptation information and how such information diffuse among rice farmers to enhance adoption of innovation designed to mitigate the impacts of climate change.

The population of the study was drawn from all the registered agricultural cooperatives societies in Anambra, Ebonyi and Enugu States who are members of Farmers Association in their various states which is 31,199. The sample size for this study constitutes 900 respondents from the population of the study, which was drawn from Anambra, Enugu and Ebonyi States. The sample size was arrived at using statistical calculations. The multistage sampling approached was used for the study.

Stage 1: Anambra, Ebonyi and Enugu States were purposely selected from the other States of the South East. This is because studies (Ogbozor, 2002, p. 129; Olori, 2006, p.4) show that these states are the most affected by climate change in the Southeast. These states are also notable for their rice production. There are Abakaliki rice, Anambra rice, Oduma and Adada rice in Enugu State.

Stage 2: Cluster sampling was used to cluster the respondents according to their registered farm associations in their various states. This to enable the research to ensure that those sampled are farmers. Since every farmer belonged to a senatorial zone and a local government area, the cluster sampling was also used to group them according to their senatorial zones and local government areas in the states under study. This is to make sure samples were drawn from all part of the states for easy generalization.

Stage 3: Having clustered the rice farmers according to their senatorial zones and local government areas in stage 2, the researcher randomly selected three local governments each from the three selected states, one from each senatorial zones of each state. In this stage, the researcher wrote down the names of all the local government areas in each of the three senatorial zones in the selected states in pieces of paper and put them in nine different bags with three bags representing three senatorial zones with their local government areas in each state. Using random sampling without replacement, the researcher selected three local government areas each from the three senatorial zones of the selected states and came of up the nine local government areas three from each state. In the end, Awka North Local Government Area was randomly selected from Anambra Central Senatorial Zone, Ayamelum LGA was selected for Anambra North and Orumba South LGA was selected for Anambra South. For Ebonyi state, lzzi LGA, was selected from Ebonyi North senatorial zone, Ezza South LGA was selected from Ebonyi Central while Afrikpo South LGA was selected from Ebonyi South. Finally, for Enugu State, Aninri LGA was selected from Enugu West Senatorial Zone, Nkanu West LGA was selected from Enugu East while Nsukka LGA was selected from Enugu North senatorial zone.

Stage 4: The researcher used purposive sampling technique to select two communities each in the selected Local Government areas. This is because rice production is not done in all the communities in the LGAs. Therefore, the researcher made a purposive decision to select those communities that are known for rice production. In Anambra State, Achalla and Ugbenu communities were selected for Awka North LGA which is in Anambra Central Senatorial Zone, Omor and Anaku communities were selected from Ayamelum LGA in Anambra North, Umunze and Ufuma communities were selected from Orumba South LGA in Anambra South LGA. For Enugu State, Oduma Community was selected from Aniri LGA in Enugu West, Adada Community was selected from Nsukka LGA in Enugu North senatorial while Nara Community was selected from Nkanu West LGA in Enugu East. For Ebonyi State, Mgbala Ukwu and Ndieze communities were selected from lzzi LGA in Ebonyi North senatorial zone, Amasiri and Igli communities were selected from Afikpo South LGA Ebonyi South while Achara-Ezza and AmaEzekwe were selected from Ezza South LGA in Ebonyi Central. It was the members of the Farmers Association who were earlier clustered that formed the respondents in the selected communities.

Data Presentation

A total of 900 copies of the questionnaire were distributed to the respondents in the three states covered by the study- the copies were allocated according to the population of registered farmers in the three selected states in South East, Nigeria. Thus, 388 were allocated to Anambra, 331 were allocated to Enugu while 181 copies of the questionnaire were allocated to Ebonyi state. Out of the 388 copies of the questionnaire distributed to the three senatorial districts, three local governments areas and six communities in Anambra state (Anambra Central- Awka Nort L.G.A: Achalla and Ugbenu), (Anambra North-Ayamelum L.G.A: Omor and Anaku), (Anambra South-Orumba South L.G.A- Umunze and Ufuma), 383 copies of the questionnaire were returned while five copies were lost. In Enugu state, out of the 331 copies of the questionnaire distributed to the three senatorial districts, three local governments areas and six communities-(Enugu East-Nkanu West: Nara and Ugwogo), (Enugu North-Nsukka: Nsukka and Adada), (Enugu West- Aninri: Oduma and

Ndiabo), 325 copies of questionnaire were returned while six copies were lost. In Ebonyi state, out of fee 181 copies of the questionnaire distributed to the three senatorial districts., three local governments areas and six communities (Ebonyi Central- Ezza North: Achara-Ezza and AmaEzekwe), (Ebonyi North- Izzi: Mgbala Ukwu and Ndieze). (Ebonyi South- Afikpo South: Amasiri and Igli). 178 copies of questionnaire were returned and three copies lost.

The total number of copies of the questionnaire returned was N=886, which represents a 97 per cent return rate.

Research Question One

What is the extent of access to information which rice farmers in southeast Nigeria have on climate change adaptation strategies?

Figure 4: Provision of Information on respondents' level of access to information on Climate Change adaptation Strategies

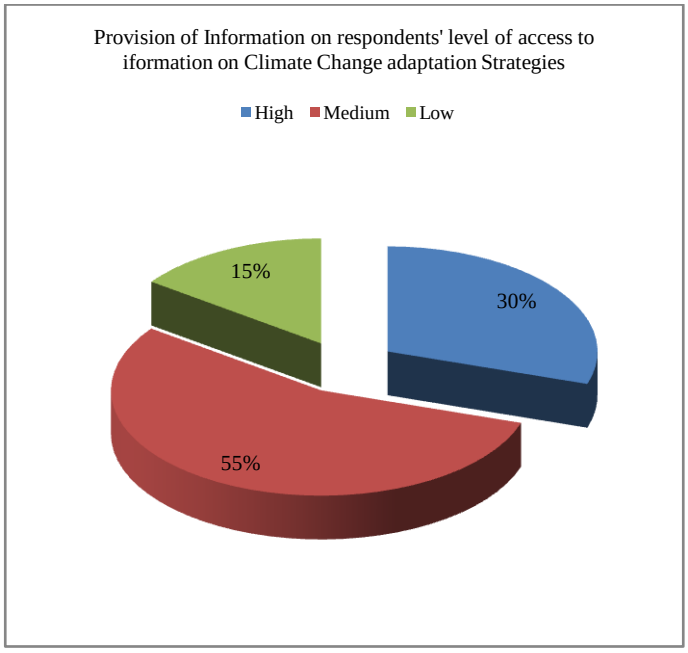

Figure 4 shows respondents' responses to research question one. Data reveals that 268 (30%) have a high level of access to information on climate change adaptation strategies, 483 (55%) respondents have medium access while 135 (15%) have low access to information on climate change adaptation strategies. Data on figure 3 imply that majority of rice farmers in the study area have high and medium access to information on strategies to adapt to climate change effects in their rice production. The study of Ghananian authors, Mensah-Fosu, Vleck and Manschadi (2010) on farmer's perceptions and adaptation to climate change strategies in the Sekyedumase district supports this finding. They found out that the most farmers have high knowledge of information on strategies to adapt to climate change effects, they perceived an increase in temperature and a decrease in precipitation which they associated with deforestation and bush burning in the area as a result of whether variation and ozone layer depletion on the planet.

Research Question Two

Which among the channels of communication is the major source of information on climate change adaptation among rice farmers in southeast Nigeria and why?

Table 1: Provision of information on Respondents' major Source of information on climate change adaptation

Response	Frequency	Percentage
Seminars/Workshops	553	63.00
Radio	197	22.00
Television	79	9.00
Newspaper	57	6.00
Total	**886**	**100.00**

Table 7 provides information on the respondents' major sources of information on climate change adaptation. Majority of the respondents 63% (n=553) identified seminars and workshops as their major source of information on climate change adaptation in their various localities. This is because such events are organized periodically, thereby putting members of the farmers association on notice to attend the seminars and workshops. Radio was next (22% n=197) because there are radio programmes targeted on farmers where they receive agricultural information. Television was (9% n=79) while only 6% (n=57) indicated newspaper as their major source of information on climate change adaptation strategies. The import of the data on Table 7 is that out of the 886 sampled rice farmers that have access to information on climate change adaptation in southeast Nigeria, the majority are exposed to the information through organized seminars and workshops other than radio, television and newspaper meaning that mass media have not been effective in communicating climate change adaptation strategies to rice farmers in southeastern Nigeria.

Research Question Three

What is the relationship between access to information and the diffusion of information on climate change adaptation among rice farmer in southeast Nigeria?

Table 2: Respondents views on the relationship between access to information and Diffusion of information

Response	Frequency	Percentage
Access enhances spread, exposure and increases awareness	688	78.00
There is no relationship	157	18.00
Can't say	41	5.00
Total	886	**100.00**

Data on Table 8 revealed that overall majority of rice farmers in the study areas accounting for 78% (n=688) indicated access enhances spread, exposure and increases the level of awareness on how to adapt to climate change effects meaning that there is a relationship between the accessibility of sources of information and diffusion of climate change adaptation strategies. However, 157 respondents representing 18%

indicated there is no relationship while five respondents representing 5% indicated can't say. Data on Table 8 imply that there is the relationship between the accessibility of sources of information and diffusion of climate change adaptation messages in that when there is easy access, there will be spread, high exposure and increase in awareness levels of rice farmers in southeastern Nigeria on adaptation strategies to climate change effects.

Research Question Four

What is the relationship between information diffusion and adoption of innovation among rice farmer in southeast Nigeria?

Table 7: Respondents views on the relationship between diffusion and adoption of adaptation strategies

Response	Frequency	Percentage
Diffusion results to the adoption of new farm technologies, methods and ideas	783	88.00
There is no relationship	65	7.00
Can't say	38	4.00
Total	886	**100.00**

Data on Table reveal that majority of rice farmers in the study areas representing for 88% (n=783) indicated that diffusion results to the adoption of the adaption strategies like enhanced farm technologies, timely planting, crop rotation, type of fertilizer to apply and soil characteristics while 65 respondents representing 7% insisted that there is no relationship between diffusion of climate change adaptation information and adoption of the adaption strategies. Only seven respondents representing 4% (n=38) indicated can't say. Data on Table 9 imply that there is the relationship between diffusion of climate change adaptation information and adoption of adaptation strategies as information spread, exposure and increased awareness will result to the adoption of adaptation strategies like enhanced farm technologies, timely planting, crop rotation, type of fertilizer to apply and soil characteristics among rice farmers in southeastern Nigeria.

Research Question Five

What is the relationship between the adoption of innovation and adaptation to climate change effects among rice farmer in Southeast Nigeria?

Table 8: Respondents' views on the relationship between adoption and adaptation to climate change effects

Response	Frequency	Percentage
Adoption results to improved crop yield, soil fertility and bumper harvest	715	81.00
There is no relationship	99	11.00
Can't say	72	8.00
Total	886	**100.00**

Data on Table 10 revealed that majority of rice farmers in the study areas representing 81% (n=715) indicated that adoption of climate change adaptation strategies like enhanced farm technologies, timely planting, crop rotation, type of fertilizer to apply and soil characteristics would result to the adaptation of climate change effects that produce improved crop yield, soil fertility, bumper harvest etc. while 99 respondents representing 11% insisted that there is no relationship between adoption of climate change adaptation strategies and adaptation to climate change effects on rice farming in southeast Nigeria. Only seven respondents representing 8% (n=72) indicated can't say. Data on Table 10 imply that there is a relationship between adoption of climate change adaptation strategies and adaptation to climate change effects as adoption result to improved crop yield, soil fertility, bumper harvest and other improvements among rice farmers in southeastern Nigeria.

Research Question Six

What are the factors that influence the adoption or non-adoption of innovation of climate change adaptation information by rice farmers in southeast Nigeria?

Table 9 Factors that Influence the adoption or non-adoption of innovation

Response	**Factors that influence the adoption or non-adoption of innovation of climate change adaptation information by rice farmers in southeast Nigeria**					
	Channel of information dissemination will influence your attitude towards innovations	Nature of information will affect your decision to adopt or not to adopt	Availability of Information source will determine if you will receive the information or not	Your literacy level and other demographic values will affect your ability to adopt or not to adopt an innovation	Perceived credibility of information will affect your acceptance of the message	Timing of information will determine whether you will adopt the innovation or not
Strongly Agree	39	27	60	15	20	78
Agree	26	58	28	26	61	12
Strongly Disagree	16	7	8	52	11	8
Disagree	11	5	2	5	5	2
Undecided	8	3	2	2	3	0
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

The data on Table 11 showed the frequency with which respondents that were sampled expressed their opinion on some factors that influence their adoption or non-adoption of innovations that will enhance their adaptation to climate change effects. The table above shows that a greater percentage of the respondents agree that channel of information dissemination will influence their attitude towards innovations at 65 per cent while only 27 and per cent of the respondents disagree and eight per cent undecided. The analysis of data presented in Table 11 also showed that greater percentage of the respondents agree that the nature of information will affect their decision to adopt or not to adopt an innovation at 85 per cent while only 15 per cent of the respondents disagreed. Again, the data laid out on the table above indicated that the respondents believe that availability of information source will determine if they will receive the information or not. The data also revealed that majority of the respondents disagree that their literacy level and other demographic values like cultural, economic, political and psychological factors will affect their ability to adapt or not to adopt an innovation at 57 per cent while 43 per cent agreed. On the perceived credibility of information, 81 per cent of the respondents agree that the perceived credibility of information will affect their acceptance of the message, while 19 per cent disagree. Finally, 90 per cent of the respondents agree that the timing of information will determine whether they will adopt the innovation or not.

IV. TEST OF HYPOTHESES

Hypothesis One

H_1 Access to information enhances the diffusion of information on climate change adaptation among rice farmers in southeast Nigeria.

Table 10: Test of the relationship between the access to information and diffusion

Responses	fo	fe	fo-fe	(fo-fe)2	Df	a	X2c	X2t	Decision rule
Yes	688	102	120	13,700	2	0.05	246	5.991	Reject Hypothesis
No	157		57	3137					
Can't Say	41		62	3755					
Total	886			18592					

The X^2 tabulated is 5.991 at 5% level of significance on the degree of freedom of 2. From this test, the calculated value X^2 is greater than the table X^2; therefore, H_0, which is the null hypothesis is rejected, and the alternative H_1 is accepted. This implies that there is a significant relationship between the access to information and the diffusion of information on climate change adaptation among rice farmer in southeast Nigeria.

Hypothesis Two

H_2 Information diffusion promotes the adoption of innovations among rice farmer in southeast Nigeria

Table 11: Test of the relationship between diffusion and adoption of innovations

Responses	fo	fe	fo-fe	(fo-fe)2	Df	a	X2c	X2t	Decision rule
Yes	783	103	120	14,400	2	0.05	209	5.991	Reject Hypothesis
No	65		57	3249					
Can't Say	38		62	3844					
Total	886			21493					

Decision rule says to reject the null hypothesis if the calculated Chi-square is greater than the table value. Since the calculated value of 209 is greater than the table value of 5.991, the null hypothesis is rejected. This means that there is a relationship between the diffusion information and adoption of innovations on climate change adaptation among rice farmer in southeast Nigeria.

Hypothesis Three

H_3 Adoption of innovation enhances adaptation to climate change effects among rice farmer in Southeast Nigeria

Table 12: Test of the relationship between the adoption of innovation and adaptation to climate change

Responses	fo	fe	fo-fe	(fo-fe)2	Df	a	X2c	X2t	Decision rule
Yes	715	103	120	14,400	2	0.05	209	5.991	Reject Hypothesis
No	99		57	3249					
Can't Say	72		62	3844					
Total	886			21493					

Decision rule says to reject the null hypothesis if the calculated Chi-square is greater than the table value. Since the calculated value of 209 is greater than the table value of 5.991, the null hypothesis is rejected. This means that there is a relationship between adoptions of innovations and adaptation to climate change among rice farmer in southeast Nigeria.

V. DISCUSSION OF FINDINGS

Research question one was designed to find out the level of access to information rice farmers in southeast Nigeria have on climate change adaptation. Finding revealed that rice farmers in southeast Nigeria have high access to information on strategies to adapt to climate change effects in their rice production. This means that there is a high awareness level of rice farmer on adaptation strategies of climate change effects in their various localities.

Research question two was designed to ascertain the communication channels that is the major source of information on climate change adaptation among rice farmer in southeast Nigeria. The finding revealed that a greater percentage of rice farmers that have access to information on climate change adaptation was exposed to the information through organized seminars and workshops other than radio, television and newspaper. This may be as a result of their literacy level, and other demographic factors as a result from an in-depth interview revealed that most of the people interviews get information mostly through radio because of their socioeconomic status.

Also, Umeje (2010) observes that the media in Nigeria appear to be relatively aloof in matters of creating awareness on climate change issues, that Nigeria risks the ravages of global challenges posed by climate change. In his assessment, the Nigerian media seem to lag in an awareness campaign on climate change and tend to leave it for individuals. Umeje's position is that most Africans are not informed on climate change and that the media have the urgent duty to assume a prominent role in creating awareness on the issues.

Research question three was designed for finding out the relationship between the access to information and the diffusion of information on climate change adaptation among rice farmer in southeast Nigeria. The finding revealed that there is a relationship between the access to information and diffusion of information on climate change adaptation in that when there is easy access, there will be spread, high exposure and increase in awareness levels of rice farmers in southeastern Nigeria on adaptation strategies to climate change effects. This finding was further tested and validated by the result of the hypothesis which was tested using inferential statistical instrument Chi-Square Goodness of Fit. The result showed the calculated value X^2 is greater than the table X^2 resulting to the rejection of the null hypothesis ($H_{0)}$ and the acceptance of the alternative ($H_{1)}$ which implies that there is a significant relationship between the accessibility of sources of information and diffusion of climate change adaptation strategies among rice farmer in southeast Nigeria.

Research question four was designed to find out the relationship between information diffusion and adoption of innovations among rice farmer in southeast Nigeria. The finding revealed that there is a relationship between information diffusion and adoption of innovation as information spread, exposure and increased awareness result to the adoption of innovations like enhanced farm technologies, timely planting, crop rotation, type of fertilizer to apply and soil characteristics among rice farmers in southeastern Nigeria. This was further validated by the result of hypothesis which was tested using the Chi-Square Goodness of fit which revealed that the calculated value X^2 is greater than the table X^2 resulting to the rejection of the null hypothesis and the acceptance of its alternative which implies that there is a significant relationship between diffusion of climate change adaptation information and adoption of adaptation strategies among rice farmer in southeast Nigeria. The finding agrees with Mbah and Ezeano (2016) who found that adaptation measures adopted by rice farmers in Benue State, Nigeria as a result of diffusion of climate change adaptation information were the use of mixed cropping, zero tillage, adjustment of planting dates, value addition of produce, crop rotation, diversification in crop and livestock production, improved land management techniques, afforestation/planting of trees, early planting of rice, early harvesting of rice, planting improved varieties of rice, mulching, bush fallowing to increase soil fertility and use of weed tolerant varieties of rice.

Research question five was designed to find out the relationship between the adoption of innovation and adaptation to climate change effects among rice farmer in Southeast Nigeria. The finding revealed that there is a relationship between adoption of innovation and adaptation to climate change effects as adoption results to improved crop yield, soil fertility, bumper harvest and other improvements among rice farmers in southeastern Nigeria. This finding was further validated by the result of hypothesis which was tested using the Chi-Square Goodness of fit which revealed that the calculated value X^2 is greater than the table X^2 resulting to the rejection of the null hypothesis and the acceptance of its alternative which implies that there is a sign between adoptions of adaptation strategies and adaptation to climate change effects among rice farmer in southeast Nigeria. This finding supports the assertion of some scholars who conclude that adaptation measures always seek to reduce the risks and impacts of climate change, moderate the adverse effects and exploit beneficial opportunity (Smith and Lenhart, 1990). Also, adaptation is a proactive process because it envisages possible future changes in the climate (Smith and Skinner, 2002). Maddison, (2006) also aver that the devastating effects of climate change can be reduced if appropriate adaptation measures are employed.

Research question six was designed to find out the factors that influence the adoption or non-adoption of innovation of climate change adaptation information by rice farmers in southeast Nigeria. The finding revealed that there is a

relationship between adoption of innovation and adaptation to climate change effects as adoption results to improved crop yield, soil fertility, bumper harvest and other improvements among rice farmers in southeastern Nigeria.

The finding showed that channel of information dissemination influences respondents' attitude towards adopting an innovation. It was also found that the nature of information affects respondents' decision to adopt or not to adopt an innovation. Again, it was found that the availability of information source determines if they will respond to the information or not. The literacy level of the respondents, as well as other demographic characteristics like cultural, economic, political and psychological factors, also affect their ability to adopt or not to adopt an innovation. On the perceived credibility of information, it was found that the perceived credibility of information affects respondents' acceptance of the message. Finally, it was revealed that the timing of information determines whether respondents will adopt the innovation or not. These findings collaborate with the views of Kroemker and Mossier (2002) that when the factors that influence an individual's response to climate change issues are taken care of, only then will a person successfully carry out a protective or positive response to the issue that will lead to adaptive or mitigation behaviour in humans. Also, the findings are in line with what this supports Deressa, Hassan, Ringler, Alemu, and Yesuf, (2009, p.550); Apata, Samuel, and Adeola,(2009, p.209) found that in Ethiopia and Nigeria, economic and cultural factors affect the audience choice of adaptation methods though this study observed that in Nigeria political and psychological factors are included among the factors.

These findings justify the theories adopted for this study. The findings have shown that Diffusion of Innovation (DOI) Theory is relevant as it explains that when farmers have access to information and adapt to new agricultural practices, there is a higher chance that food production will increase at the level of households and nationally will enhance food security. The new agricultural knowledge acquired by the farmers will either be adapted to suit their environment or neglected (non-adaptation). To adapt, farmers will need supporting mechanisms or an environment which enhances the knowledge transformation to impact agricultural production. These include timely access to information, a well-framed institutional framework for information transfer, proper infrastructure, confidence as a result of practice and the availability of financial services. On the other hand, the failure to adapt can be caused by the lack of timely access to information sources, education (formal or informal), attitude, poverty, economy, and inadequate knowledge, poor infrastructure such as roads and dwellings, and ignorance

VI. CONCLUSION

It has been established in this study that adaptation to climate change effects to ensure food security in Nigeria cannot be achieved if there is limited access to information and its proper diffusion among rice farmers. Also, it has been established that there is a relationship between some variables like accessibility, diffusion, adoption and adaptation of information on how to mitigate the impact of climate change effects among rice farmers. This means that provision of information is not enough. Still, the ability of rice farmers to have access to it spread the information, adopt the message contained in the information provided and apply rice production process are keys to containing the effects of climate change to ensure food security in Nigeria knowing that climate change is likely to exacerbate existing problems for rice farmers in southeast Nigeria and create new risks if it is not mitigated timeously.

VII. RECOMMENDATIONS

Based on the research findings, the researcher, therefore, made the following recommendations:

1. .All the channels of communication should be effectively employed to disseminate timely information on climate change adaptation to reach a broader audience.
2. The mainstream media should deliberately get more involved in dissemination information on climate change adaptation strategies effectively to farmers in general and rice farmers in particular.
3. Agricultural Research institutions in Nigeria should endeavour to come up with a scientific method and modern innovations that can be adopted by rice farmers to effectively mitigate the effects of climate change and variability.
4. Further studies should be conducted to evaluate media coverage of climate change adaptation strategies and its influence on agricultural development in Nigeria

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